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CGNET: A DATA TRANSFER NETWORK FOR THE CGIAR

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Computer-based messaging, bulletin-board and conferencing systems are increasingly being used as the computer and telecommunication technologies converge. With the exponential growth of information, especially in the scientific and technical domain, the need for effective and efficient methods for the transfer of information is becoming ever more pressing. Data communication techniques, non-real time and relatively low-cost in nature, with hard copy outputs if desired, can facilitate this information exchange. Recognizing these facts, the International Development Research Centre is developing a program of support for the promotion and use of these techniques in support of research activities in developing countries.

Support for CGNET, a data transfer network for the Consultative Group on International Agricultural Research, has been an important part of this program. In 1983, an intensive "data transfer network feasibility study" for the CGIAR community was carried out. This led, in late 1983 and throughout 1984, to a computer-based message system pilot project. The result, CGNET, is now operational for eight of the thirteen Centres, the CGIAR and TAC Secretariats and a number of associated institutions and remote sites both in developing and developed countries.

As CGNET expands and develops, the CGIAR system is playing a pioneering role in the use of new communication technologies by not-for-profit organizations.

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Information gains value once it is exchanged or consumed. To be exchanged or consumed it must be transferred or delivered. The need for effective and efficient means to carry out this process is becoming ever more pressing with the exponential growth of information, especially in the scientific and technical domain. With the distinction between the computer and telecommunication technologies disappearing, a number of communication techniques have been developed to facilitate this process and are increasingly being used in the world today.

Packet Switching (1)

These communication techniques are proliferating partly as a result of the implementation of packet switching networks and the resulting savings in cost and time.

Communication between individuals is characterized by bursts. In fact, it has been estimated that over sixty per cent of a typical conversation involves silent periods. In circuit switched systems (the systems which handle conventional telephone conversations), a fixed bandwidth is alloted for the duration of a telephone (or telex) call. This means that there is a physically maintained connection between the two points in the communication with an obvious waste of transmission resources.

Packet switching was developed initially for interactive applications with computers (on-line retrieval). Communications sent by a terminal are broken into short packets with source, destination and serial information attached to each packet. Packets are transmitted through nodes in the network by the most appropriate available route, and are retransmitted if acknowledgement of reception from any node is not received. The packets are then reassembled at the destination.

The network is shared by many users and bandwidth is not exclusively reserved for any one user. The result is more reliable, secure and speedy transmission of information with the cost based more on the quantity of information transferred rather than on time or distance.

On the international level, the national packet switching networks (Canada - DATAPAC, INFOSWITCH; USA - TYMNET, TELENET; France - TRANSPAC; Ivory Coast - SYTRANPAC; Gabon - GABONPAC; etc.) are interconnected through international gateways (2) (United States - ITT, RCA, WUI; Canada - Teleglobe; Paris - NTI; London - IPSS; etc.). Every year more countries are establishing such links through these gateways. As this process continues the opportunities for reliable and relatively inexpensive data communication between any points on the globe will increase.

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Computer-Based Messaging and Conferencing: An Overview

One of the most promising communications techniques to be used extensively since the beginning of this decade is computer-based messaging. In such systems, a user composes a message using a computer terminal, and then transmits it, along with addressing information, to a computer via telecommunications links. A host computer, with appropriate software, manages the message electronically. When the addressee signs on to that computer, he or she receives delivery of the message, along with any others that are waiting. These systems are similar to telex but are much less expensive, and provide additional facilities such as upper and lower case characters, individualized formatting, forwarding of messages, automatic acknowledgement, multiple addressees for a message, and so on.

As an extension of this concept, systems designers developed what are now called computer-based conferencing systems (3), allowing many-to-many communications on specific topics. Such systems allow groups of people scattered around the world to discuss topics of common interest, such as scientific issues or administrative matters. The storage, retrieval, and processing capabilities of the computer, coupled with the appropriate software, permit the management and tracking of messages in a computer conference. A computer with conferencing software can

manage many conferences simultaneously, in addition to allowing personal messaging. In effect, one can participate in what could be called the "plenary" session of a conference discussion (computer conferencing) while at the same time one can be engaged in "corridor chatter" (computer messaging). Conferences can be structured as being public, open to all those with access, or private, open to only those who have been registered as participants. Some of these systems have additional features such as allowing joint authorship of papers, cross-referencing and selective retrieval of text, and even a voting facility for consensus gathering.

Perhaps the key characteristic of these systems is their asynchronous nature (senders and recipients communicate via the computer in non-real time). Certain advantages ensue as a result. Problems of communicating across time zones and the frustrations of making connections over the telephone disappear. One is able to participate in many electronic conferencing activities while at the same time conducting one's regular work. Individuals are able to ensure greater accuracy in their communications as they communicate while remaining close to their own data sources. In effect, the quality of communications is improved as individuals control the location, time, and rate of their communications. It has also been demonstrated that computer conferencing nurtures information transfers which would not have taken place with traditional means alone.

Applications of these systems for Information and Documentation Centres would include: simple question and answer exchanges; facilitation of search strategy formulations; report/newsletter generation and editing; on-line ordering of documents; facilitation of interlibrary loan processes; face-to-face meeting preparation and follow-up; and topic specific discussions.

An IDRC Workshop on Computer-Based Conferencing

It became evident at IDRC* that these new communications techniques were being utilized more and more in the industrialized world, and there was concern that Third World institutions would be left out of the design, implementation, and use of the rapidly expanding networks. In order to explore the state of the art and receive advice on any potential role for donors, IDRC convened a week-long workshop in October 1981, entitled "Computer-Based Conferencing Systems for Developing Countries" (4). It was perhaps indicative of the need for that workshop that only isolated pockets of activity in this field could be found in developing countries.

*The International Development Research Centre is a public corporation established by an Act of Parliament in Canada in 1970 to support research activities for development in developing countries.

Experts from Brazil, India, international organizations involved in the informatics field, and those involved with existing systems discussed current and proposed systems, advantages and disadvantages, impediments to implementation, and possibilities for developing countries.

The experts at the workshop were unanimous in stating that the greatest impediments to the implementation of international computer conferencing systems would be legal and regulatory, rather than technical. In many countries, national communications authorities do not look kindly on inexpensive digital communications techniques competing with the lucrative traditional communications monopolies they now manage. The compensating national benefits of allowing improved scientific communications via these techniques obviously need to be emphasized to these authorities.

It was the consensus of the workshop that these systems would be an integral part of the available communications options in the coming decade and that, unless the developing nations could participate in this electronic community of science and technology, they would suffer from disenfranchisement of a serious nature. This might take the form of a lack of access to the resources of the developed nations and the inability to gain timely access to results and techniques found in the developing countries themselves.

The participants in the meeting felt that there was a role for donors to play in this area and identified the need for a sufficient base of knowledge and experience related to these new information technologies.

Accordingly, within the Information Sciences Division of IDRC, a modest program in the area of telecommunication systems was established. More specifically, the focus of this program has been on data communications techniques in support of research activities. Its objective is to facilitate and support developing-country involvement in the testing, experimentation, development and use of these techniques in order that they can make informed decisions on the appropriateness of these techniques for their needs.

CGNET: Communications For Agricultural Research

The Consultative Group on International Agricultural Research (CGIAR) is an international consortium sponsored by the World Bank, the United Nations Development Program, and the Food and Agriculture Organization of the United Nations, dedicated to supporting research programs with the purpose of improving the quantity and quality of food production in the developing world.

These programs are carried out by thirteen autonomous international agricultural research centres (IARCs): Centro Internacional de Agricultura Tropical (CIAT), Cali, Colombia; Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico; Centro Internacional de la Papa (CIP), Lima, Peru; International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria; International Rice Research Institute (IRRI), Manila/Los Banos, Philippines; Internatonal Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Hyderabad, India; International Laboratory for Research on Animal Diseases (ILRAD), Nairobi, Kenya; International Livestock Center for Africa (ILCA), Addis Ababa, Ethiopia; International Center for Agricultural Research in the Dry Areas (ICARDA), Aleppo, Syria; West Africa Rice Development Association (WARDA), Monrovia, Liberia; International Service for National Agricultural Research (ISNAR), The Hague, Netherlands; International Food Policy Research Institute (IFPRI), Washington, D.C., U.S.A.; International Board for Plant Genetic Resources (IBPGR), Rome, Italy; and two Secretariats, the CGIAR Secretariat at the World Bank in Washington and the Technical Advisory Committee Secretariat at FAO in Rome, Italy.

In 1982, with conventional communications costs rising, budgets restricted or shrinking, the need for international scientific and administrative communications increasing, and the recent availability of a number of technical solutions, the CGIAR system

decided that the time was ripe to explore the technical, legal, administrative, and economic feasibility of the implementation of a data transfer network for the IARCs. Two earlier studies had made initial recommendations, but for a variety of reasons these had not been pursued.

Following a meeting of CGIAR Centre Directors in 1982, a study was commissioned by the CGIAR and IDRC to look first at a system to handle inter-centre communications needs. IDRC was interested in this activity from both the standpoint of discovering what was possible and how appropriate it would be, as well as the possible demonstration effect that would ensue as a result of an operational network being implemented.

During the first phase of the feasibility study, the consultants concluded that the primary services of a CGIAR data transfer network should be computer-based message services and gateway facilities from the computer-based messaging system to on-line database services. It was also determined that the prospects of a full implementation of a CGIAR data transfer network would be enhanced if a pilot project were established. Such a project would maintain and strengthen the momentum within the CGIAR system toward the implementation of new communications technologies. Since there were existent international computer-based messaging services, some, but not all, of the Centres could participate with little or

no acquisition of equipment or technology. This would give the Centres and the associated Secretariats exposure to some of the practical problems and implications of establishing an operational system. They would have the opportunity to contemplate the managerial and financial implications resulting from the use of computer-based messaging services. As such, they would have a stronger basis for judging any eventual recommendation regarding full network implementation.

In addition, the consultants recommended that the original target group to be studied, the thirteen IARCs and two Secretariats, should be expanded to include some of the important remote research sites. As a result, a project, funded jointly by the CGIAR and IDRC, was initiated to conduct a feasibility study on the implementation of a data transfer network for the CGIAR system including sites involved in a major share of information flow to and from the centres but which were not located at any of the 15 primary sites, and to establish, administer, monitor, and evaluate a small computer-based message system pilot project for the CGIAR system.

The project was completed in 1984, resulting in an operational network, CGNET, linking, through the international gateways, nine of the fifteen major sites (all but ICRISAT, ILCA, ILRAD, ICARDA, IITA, and WARDA) along with some of their remote sites (for

example, Bangkok, where CIMMYT, IRRI and CIAT have programs) and many other institutions with which they conduct business and research. A commercial US-based messaging/conferencing system acts as the host system for the network. Subscribers to this system, of interest to the CGIAR, include universities; government departments (USDA); financial institutions; donors (US AID, GTZ, IDRC); suppliers (Institute for International Education); and the Commonwealth Agricultural Bureau (CAB), among others.

One of the IARC's, ICRISAT in Hyderabad, India, without access to the international gateways, experimented during the project with participation in the network via a relay computer located in the United States. With direct distance dialing from the United States to ICRISAT's computer, messages are dropped and others are picked up and then entered into CGNET via a microcomputer/human interface. Even with this more complicated routing, ICRISAT has become one of the system's heaviest users.

Applications which have been tested or implemented, or will or could be in the future, are described below. Results of germplasm testing can be transmitted with valuable time saving economies. CIMMYT and ICRISAT, and CIAT and IRRI, are interested in nursery data transfers. These applications, of a true data transfer nature, will require secure error detection protocols. The use of lap computers to collect data in the field, along with

computer-based messaging facilities, will expedite the transfer of time critical information. Administrative/management applications include: the communication of financial information; communication among members of Centres' Boards of Directors and between the Boards and their respective Centres; communication among members of the Technical Advisory Committee; communication among standing committees; etc. The maintenance of cooperative mailing lists and directories can be facilitated. On going subject-specific discussions can be carried out through computer conferencing. Joint research projects can be more effectively managed, monitored and evaluated. The telex-refiling capability has been used effectively with considerable cost savings. This facility allows telexes to multiple destinations to be sent within the U.S., at domestic rates, with the submission of one message to the computer-based messaging system. In a similar vein, reports can be sent physically within the U.S. with the use of a facility transferring messages (the report) from the messaging system to physical delivery mechanisms. For those Centres without local data storage devices, the system can act as an intermediary to bibliographic information systems and then the results can be saved within the system for later editing and forwarding. CIMMYT has been able to cut in half (9 months to 4 or 5 months) the turn around time for the abstracting of its publications by CAB. As well, CIMMYT, one of the heaviest users of the system, has implemented automatic routing of messages from any terminal at

CIMMYT so that messages are delivered locally, to the CGNET system or routed to telex as appropriate.

Besides the obvious benefits for some with the facilitation of communications, several impacts from this activity deserve mention. As a result of the Communication Audit, used by the consultants in carrying out the feasibility study, several Centres became more fully aware of their dependence on communication and the significant expenditures in this area. Accordingly, their mode of operation was altered and major investment decisions concerning hardware/software and telecommunications were made.

But perhaps the most important impact is the potential for cost savings while improving the efficiency and effectiveness of their operations. The consultants who carried out the study prepared a cost model to predict savings impact. They included all 15 major sites (including the six which would use the relay method previously described) and the costs of high quality modems but not terminal equipment which in nearly all cases already is in place over a seven year period. They provided three scenarios: the pessimistic case where savings of $1 million would be realized with an estimated 7% annual growth in communication costs and a 13% annual displacement of costs due to the CGNET; the minimum expected case where $3.3 milion would be realized with 13% growth in costs and 23% displacement; and an optimistic case where $5.7 million

would be realized with a 13% growth and 35% displacement. In actual fact, growth in communication costs have been historically much higher than those used in the model and displacement of costs due to CGNET use could be higher than estimated with increase in its use, quality of use, and the number of users.

During the project, problems or impediments to greater use of the system were identified. These are: lack of direct access to terminal equipment (the traditional telex model of distribution does not encourage use of these systems); lack of training; lack of staff awareness in the system and its capabilities; the lack of more institutions connected to the network; and the lack of more participation by some individuals at institutions already in the network.

To date, the majority of applications have been mainly administrative. Scientific applications and library applications have not been as significant. There are a number of areas to pursue in rectifying this situation. For the successful use of asynchronous communications networks, a critical mass of regular users is required to ensure that it is worthwhile for any one user to log on to the system. As with most technologies, training, both initial and ongoing, is probably the single most important investment. Related to training, with new information/communications technologies there appears to be a conditioning process

required whereby resistance to change must be overcome. This can be accomplished by sensitization workshops, hands-on experience, encouragement by peers and supervisors, and the demonstration of the effectiveness of the technologies. Finally, it is very difficult to implement a variety of applications of a technology simultaneously. A step-by-step approach is usually advisable. For each application, an individual with the appropriate technical, organizational, and personal skills, is required to blaze the trail. I believe the information centres could be the logical foci for taking the lead in the implementation of these technologies.

As CGNET matures, user groups will expand, applications will be tried, and implemented if appropriate (including computer conferencing, bulletin boards, telex-refiling, database access, data transfer, etc.), and new locations will be added to the network.

This will place the CGIAR at the forefront of international scientific networks working towards global development in the use of information technologies.

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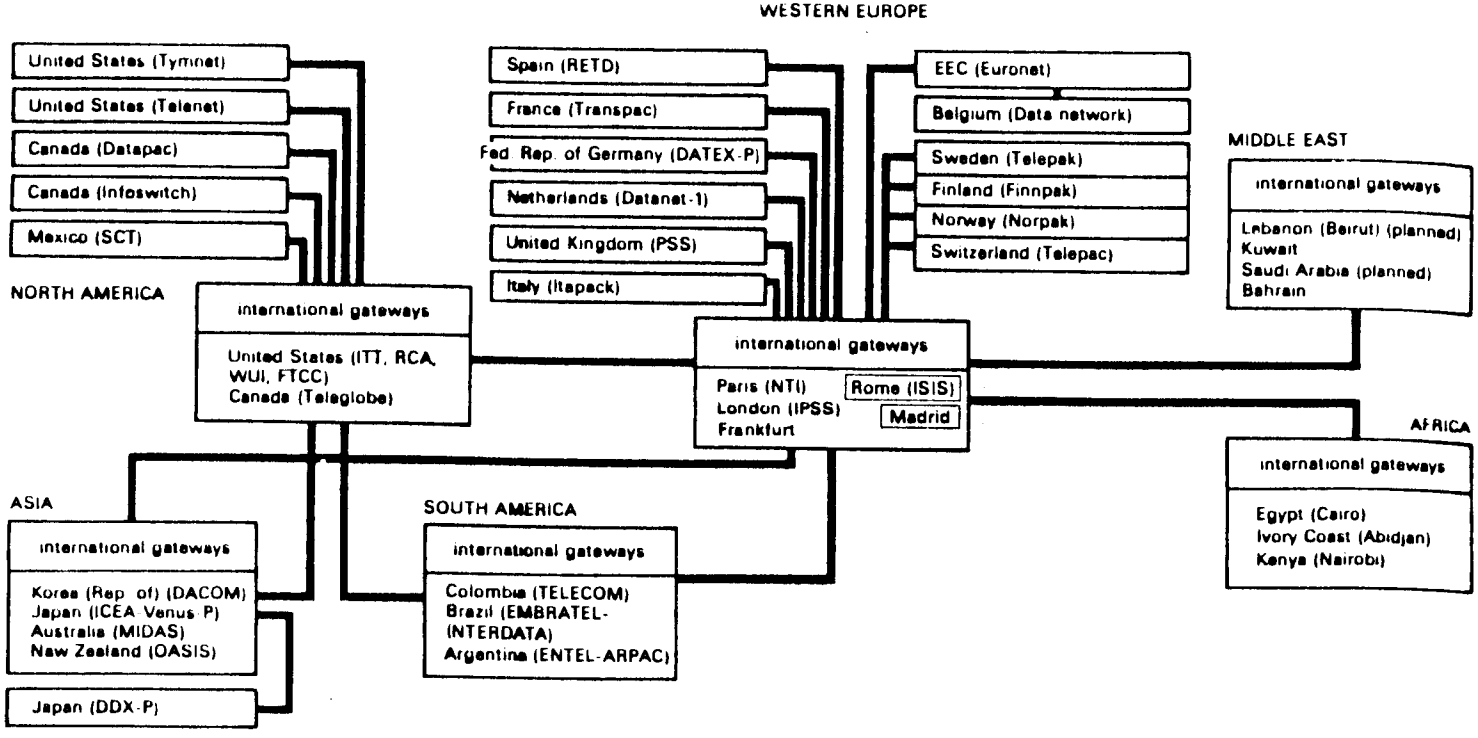
COUNTRIES WITH TYMNET ACCESS

ALASKA (See United States)	ANTIGUA
ARGENTINA	AUSTRALIA
AUSTRIA	BAHAMAS
BAHRAIN	BARBADOS
BELGIUM	BERMUDA
BRAZIL	CANADA
CAYMAN ISLANDS	CHILE
CHINA	COLOMBIA
COSTA RICA	DENMARK
DOMINICAN REPUBLIC	EGYPT
FINLAND	FRANCE
FRENCH OVERSEAS TERRITORIES	GABON
GAMBIA	GERMANY (West)
GREECE	GUAM (See United States)
GUATEMALA	HONDURAS
HONG KONG	HUNGARY
INDONESIA	IRAQ
IRELAND	ISRAEL
ITALY	IVORY COAST
JAMAICA	JAPAN
KOREA (South)	KUWAIT
LUXEMBOURG	MEXICO
NETHERLANDS	NEW ZEALAND
NORWAY	PANAMA
PERU	PHILIPPINES
PORTUGAL	PUERTO RICO (See United States)
QATAR	SAUDI ARABIA
SINGAPORE	SOUTH AFRICA
SPAIN	SWEDEN
SWITZERLAND	TAIWAN
THAILAND	TRINIDAD AND TOBAGO
UAE	UNITED KINGDOM
UNITED STATES	


WESTERN EUROPE
United States (Tymnet)
United States (Telenet)
Canada (Datapac)
Canada (Infoswitch)
Mexico (SCT)
NORTH AMERICA
international gateways
United States (ITT, RCA, WUI, FTCC)
Canada (Teleglobe)
Spain (RETD)
France (Transpac)
Fed. Rep. of Germany (DATEX-P)
Netherlands (Datanet-1)
United Kingdom (PSS)
Italy (Itapack)
EEC (Euronet)
Belgium (Data network)
Sweden (Telepak)
Finland (Finnpak)
Norway (Norpak)
Switzerland (Telepac)
international gateways
Paris (NTI)
London (IPSS)
Frankfurt
Rome (ISIS)
Madrid
MIDDLE EAST
international gateways
Lebanon (Beirut) (planned)
Kuwait
Saudi Arabia (planned)
Bahrain
AFRICA
international gateways
Egypt (Cairo)
Ivory Coast (Abidjan)
Kenya (Nairobi)
ASIA
international gateways
Korea (Rep. of) (DACOM)
Japan (ICEA Venus P)
Australia (MIDAS)
New Zealand (OASIS)
Japan (DDX-P)
SOUTH AMERICA
international gateways
Colombia (TELECOM)
Brazil (EMBRATEL-(INTERDATA)
Argentina (ENTEL-ARPAC)